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(71) Applicant
NEC Corporation
 (Incorporated in Japan)
 7-1, Shiba 5-chome, Minato-ku, Tokyo, Japan

(72) Inventors
Tomoshi Sone
Hisashi Kondo

(74) Agent and/or Address for Service
Mathys & Squire
 10 Fleet Street, London, EC4Y 1AY, United Kingdom

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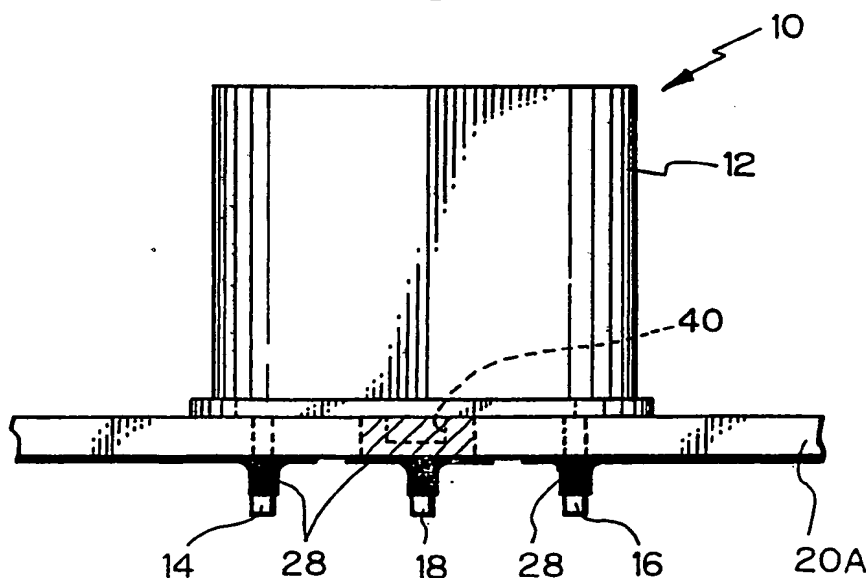
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(58) Field of search
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INT CL⁶ H05K
Online databases: WPI

(54) **Circuit board for mounting a band-pass filter**

(57) The circuit board 20A includes an elongate through hole 40 formed through the ground surface of the circuit board for shielding the input and output terminals 14, 16 of a band-pass filter from each other. The through hole eliminates unexpected coupling between the input and output terminals within the circuit board. Solder 28 which flows into the through hole allows the casing of the filter to closely contact the ground surface of the circuit board.

Fig. 4B



GB 2 268 000 A

Fig. 1A

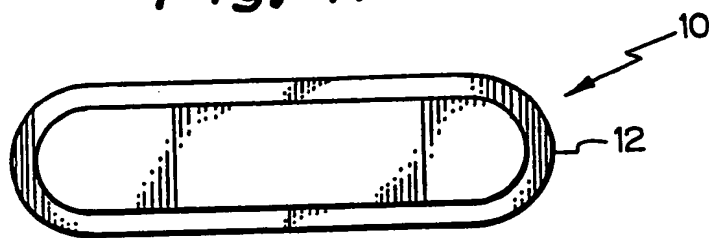


Fig. 1B

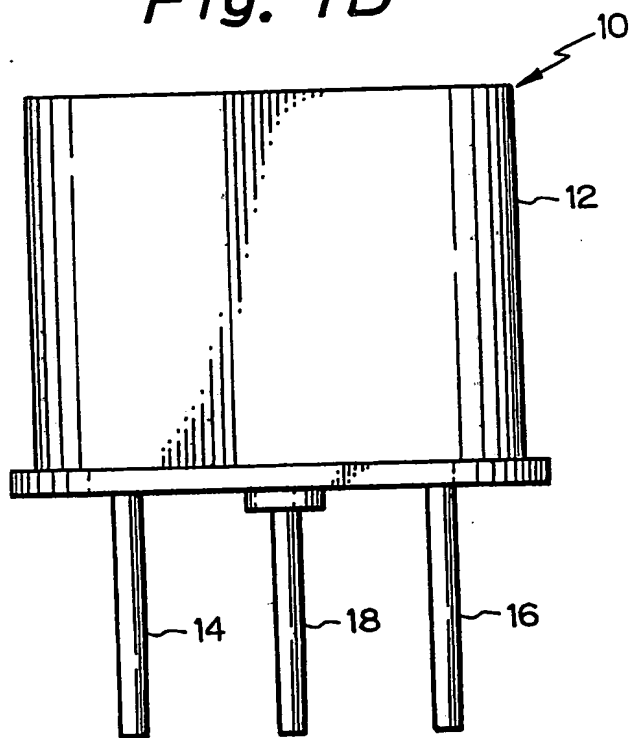


Fig. 1D

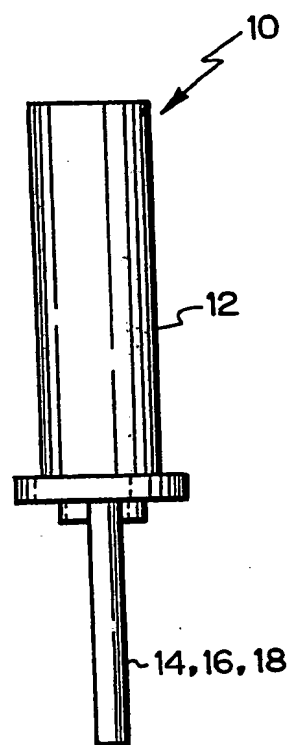


Fig. 1C

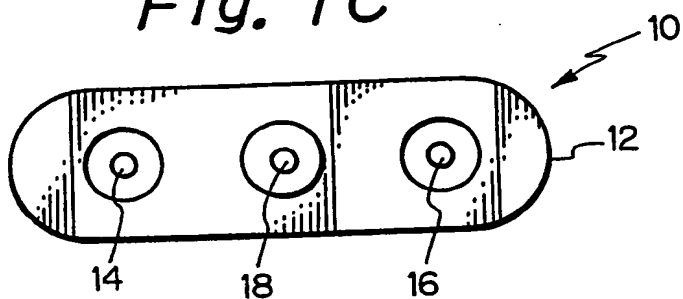


Fig. 2A

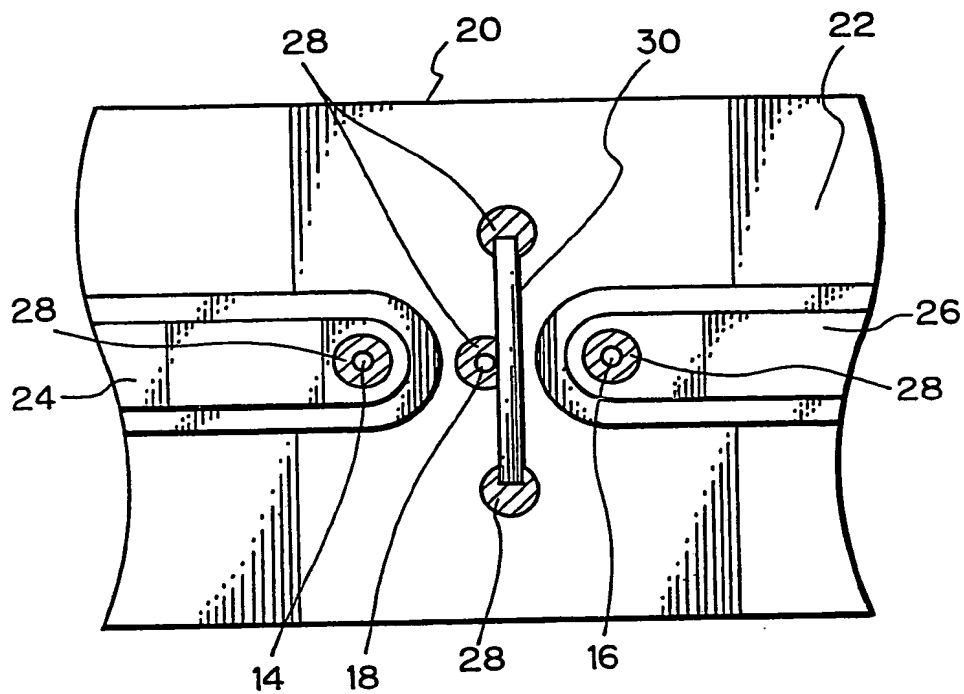


Fig. 2B

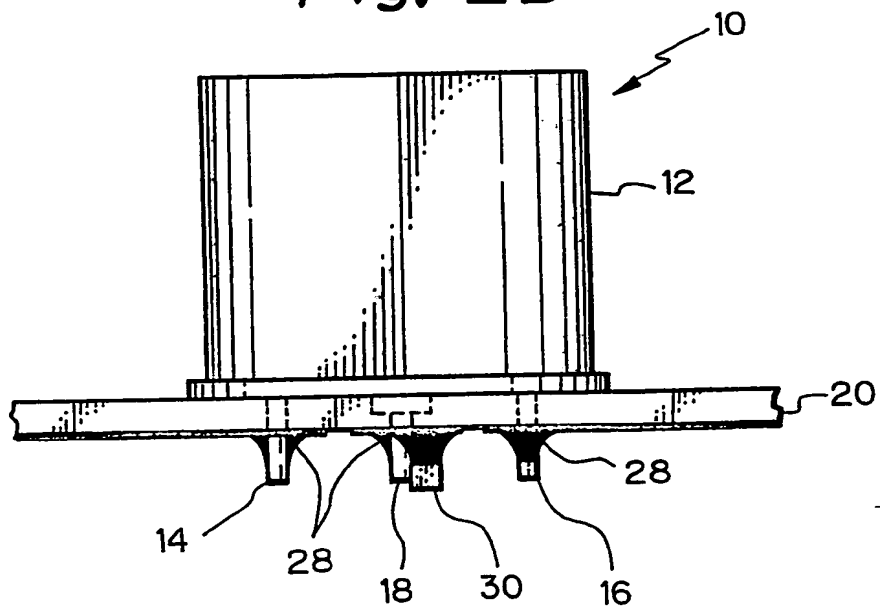


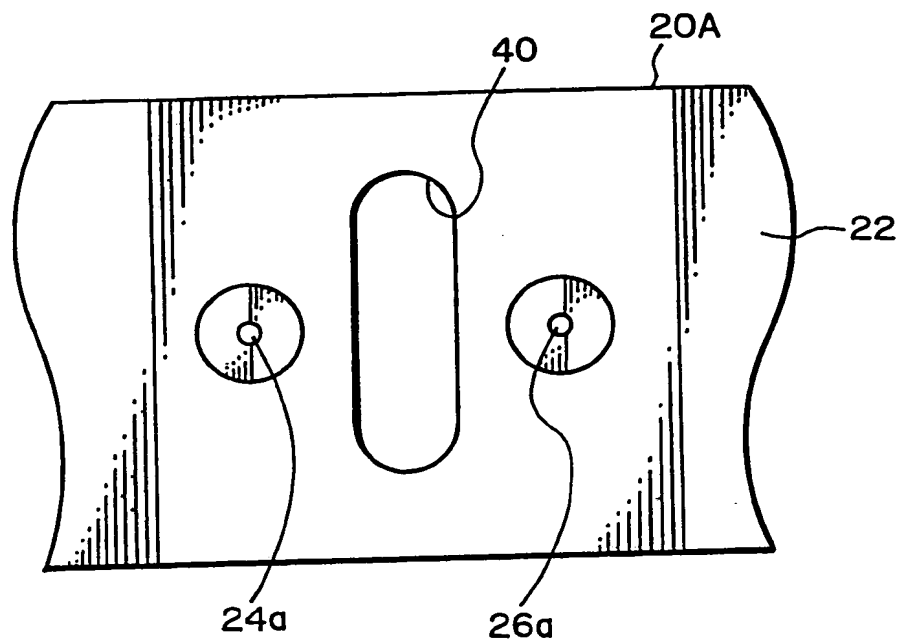
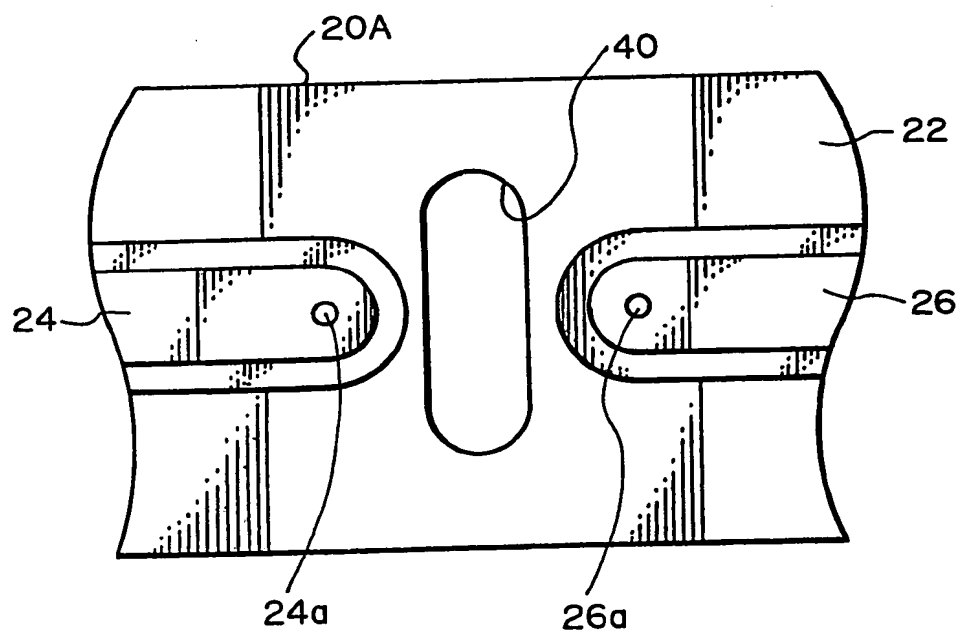
Fig. 3A*Fig. 3B*

Fig. 4A

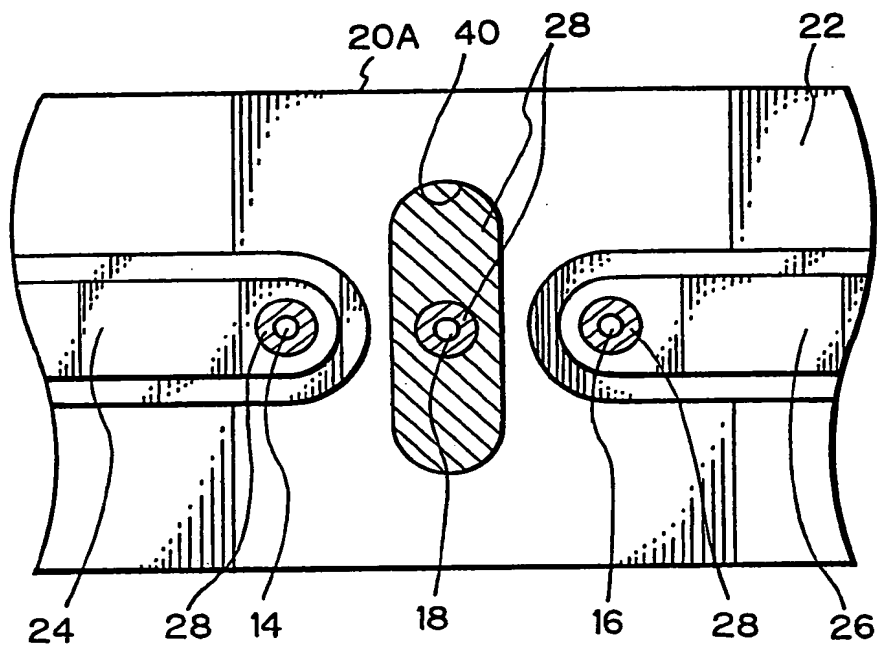
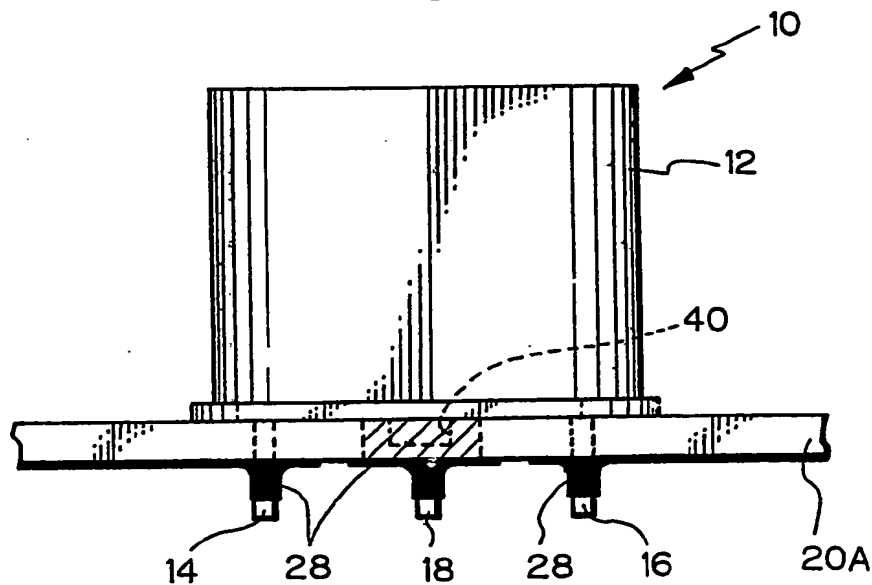


Fig. 4B



CIRCUIT BOARD FOR MOUNTING A BAND-PASS FILTER

BACKGROUND OF THE INVENTION

The present invention relates to a circuit board for mounting a band-pass filter and, more particularly, to the land configuration of the area of a circuit board where a
5 band-pass filter is to be located.

A band-pass filter is extensively used with, for example, a mobile radio communication apparatus since it has a strict electric characteristic and is highly resistive to environments, small size, and light weight. Generally, a
10 band-pass filter has a casing made of metal or similar conductive material and accommodating major circuitry therein, and an input terminal, an output terminal and a ground terminal extending out from the bottom of the casing. The input, output and ground terminals are respectively
15 soldered to an input line, an output line and a ground surface provided on a circuit board. This configuration, however, has a drawback that unexpected coupling is apt to occur between the input and output terminals of the filter, preventing a desired frequency band characteristic or similar electric
20 characteristic from being achieved. To eliminate such

coupling, it is a common practice to locate a shield between the input and output terminals on the circuit board. It has been reported that assuming specifications prescribing an attenuation at an image frequency, i.e., a simple
5 characteristic of greater than 56 dB, the attenuation achievable with the shield is 56.0 dB at an image frequency of $f_0(21.7 \text{ MHz}) - 910 \text{ kHz}$, which is higher than 40.0 dB available with a circuit board lacking the shield.

However, the unexpected coupling between the input and
10 output terminals also occurs within the circuit board, and this cannot be coped with by the shield. Moreover, since the casing of the filter is connected to the ground surface of the circuit board only at the ground terminal thereof, an impedance exists between the casing and the ground surface.
15 This impedance is likely to degrade the desired electric characteristic of the filter.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to
20 provide a circuit board which eliminates undesirable coupling between the input and output terminals of a band-pass filter within the circuit board and allows the casing of the filter to closely contact the ground surface thereof.

The present invention provides a circuit board for mounting
25 a band-pass filter having a casing and an input

terminal, an output terminal and a ground terminal affixed to said casing, the ground terminal being disposed between the input and output terminals, the circuit board comprising a ground surface, an input line and an output line having portions to which the input terminal and the output terminal of the band-pass filter respectively are to be connected, and a through hole formed through the ground surface and disposed between the said portions of the input and output lines. The invention also includes the combination of a circuit board with a band-pass filter connected thereto as set forth above.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will become more apparent from the following detailed description taken with the accompanying drawings in which:

FIGS. 1A, 1B, 1C and 1D show a conventional band-pass filter in a plan view, a front view, a bottom view, and a side elevation, respectively;

FIGS. 2A and 2B are respectively a bottom view and a side elevation showing the conventional filter mounted on a circuit board;

FIGS. 3A and 3B are respectively a plan view and a rear view of a circuit board embodying the present invention and applicable to a band-pass filter; and

FIGS. 4A and 4B are respectively a bottom view and a side elevation showing the embodiment on which a band-pass filter is mounted.

DESCRIPTION OF THE PREFERRED EMBODIMENT

5 To better understand the present invention, a brief reference will be made to a conventional band-pass filter, shown in FIGS. 1A, 1B, 1C and 1D. As shown, the band-pass filter, generally 10, has a casing 12 made of metal or similar
10 conductive material and accommodating major circuitry therein. An input terminal 14, an output terminal 16 and a ground terminal 18 extend out from the bottom of the casing 12.

FIGS. 2A and 2B show the band-pass filter 10 mounted
15 on a circuit board 20. As shown, the circuit board 20 has a ground surface 22. An input line 24 and an output line 26 are provided on the circuit board 20 at a position where the filter 10 is to be located. To affix the filter 10 to the circuit board 20, the input terminal 14, output terminal 16 and ground
20 terminal 18 of the filter 10 are respectively connected to the input line 24, output line 26 and ground surface 22 of the circuit board 20 by solder 28. The problem with this kind of configuration is that unexpected coupling is apt to occur between the input terminal 14 and the output terminal 16 of
25 the filter 10, preventing a desired frequency band

characteristic or similar electric characteristic from being achieved. In the light of this, it has been customary to locate a shield 30 between the input terminal 14 and the output terminal 16 on the circuit board 20 and connect it to the board 20 by solder 28. It has been reported that assuming
5 specifications prescribing an attenuation at an image frequency, i.e., a simple characteristic of greater than 56 dB, the shield 30 realizes an attenuation of 56.0 dB at an image frequency of $f_0(21.7 \text{ MHz}) - 910 \text{ kHz}$, which is contrastive to
10 40.0 dB particular to a case without the shield 30.

However, since the unexpected coupling between the input terminal 14 and the output terminal 16 also occurs within the circuit board 20, the shield 30 is not a satisfactory measure. Moreover, since the casing 12 of the
15 filter 10 is connected to the ground surface 22 of the circuit board 20 only at the ground terminal 18 thereof, an impedance exists between the casing 12 and the ground surface 22. This impedance is likely to degrade the desired electric characteristic of the filter 10.

20 Referring to FIGS. 3A, 3B, 4A and 4B, a circuit board embodying the present invention and applicable to a band-pass filter will be described. In the figures, the same constituents as the constituents shown in FIGS. 1A-1D, 2A and 2B are designated by the same reference numerals, and a detailed
25 description will not be made to avoid redundancy

FIGS. 3A and 3B show a circuit board 20A embodying the present invention in a plan view and a bottom view, respectively. As shown, the circuit board 20A has a ground surface 22. Holes 24a and 26a are formed through the circuit board 20A for receiving an input terminal 14 and an output terminal 16 extending out from a band-pass filter 10, respectively. An input line 24 and an output line 26 are provided on the rear of the circuit board 20A so as to be soldered to the terminals 14 and 16, respectively. In the illustrative embodiment, an elongate through hole 40 is formed through the ground surface 22 of the circuit board 20A and perpendicularly traverses an imaginary line connecting the input terminal 14 and output terminal 16.

The band-pass filter 10 is mounted on the circuit board 24A, as shown in FIGS. 4A and 4B in a bottom view and a side elevation, respectively. As shown, the input terminal 14 and the output terminal 16 of the filter 10 are respectively connected to the input line 24 and the output line 26 of the circuit board 20A by solder 28. A ground terminal 18 also extending out from the filter 10 is passed through the through hole 40 and affixed to the circuit board 20A by solder 28. Specifically, the solder 28 flows into and stops up the through hole 40, as indicated by hatching in the figures. This is successful in further enhancing the shield effect between the input terminal 14 and the output terminal 16 within the

circuit board 20A. In addition, the solder 28 flown into the through hole 40 in a great amount allows the casing 12 of the filter 10 to closely contact the ground surface 22 of the circuit board 20A, so that the impedance between the casing
5 12 and the ground surface 22 is noticeably reduced.

Experiments showed that assuming specifications of the filter 10 prescribing an attenuation at an image frequency, i.e., a simple characteristic of greater than 56 dB, the circuit board 24A realizes an attenuation of 62.0 dB at an image
10 frequency of $f_0(21.7 \text{ MHz}) - 910 \text{ kHz}$. In this respect, the through hole 40 constitutes a remarkable improvement over the conventional shield 30

In summary, a circuit board embodying the present invention prevents undesirable coupling from occurring
15 between the input and output terminals of a band-pass filter within the board without resorting to the modification of a conventional band-pass filter. This, coupled with the fact that the casing of the filter closely contacts the ground surface of the circuit board, makes the most of the electric
20 characteristic particular to the filter.

Various modifications will become possible for those skilled in the art after receiving the teachings of the present disclosure without departing from the scope thereof.

CLAIMS

1. A circuit board for mounting a band-pass filter having a casing and an input terminal, an output terminal and a ground terminal affixed to said casing, said ground terminal being disposed between said input terminal and said output terminal, said circuit board comprising:

a ground surface;

an input line and a output line having portions to which the input terminal and the output terminal of the band-pass filter respectively are to be connected; and

a through hole formed through said ground surface and disposed between the said portions of the said input line and the output line.

2. A circuit board as claimed in claim 1, wherein said through hole is elongate and perpendicularly traverses an imaginary line connecting the said portions of the input line and the output line.

3. In combination, a band-pass filter having a casing, an input terminal, an output terminal and a ground terminal affixed to said casing, said ground terminal being disposed between said input terminal and said output terminal, and a circuit board, the circuit board comprising: a ground surface; an input line and an output line to which the input terminal and the output terminal of the band-pass filter respectively are connected; and a through hole formed through said ground surface and disposed between the input terminal and the output terminal of the band-pass filter.

4. A circuit board as claimed in claim 3 wherein said through hole is elongate and perpendicularly traverses an imaginary line connecting the input terminal and the output terminal of the band-pass filter.

5. A circuit board as claimed in claim 4 or claim 5, wherein the casing of the band-pass filter is closely connected to said ground surface by solder in said through hole.

6. A circuit board substantially as herein described with reference to Figures 3 and 4 of the accompanying drawings.

7. The combination of a circuit board and a band-pass filter substantially as herein described with reference to Figures 3 and 4 of the accompanying drawings.

- 10 -

Patents Act 1977
Examiner's report to the Comptroller under
Section 17 (The Search Report)

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Relevant Technical fields

(i) UK Cl (Edition L) H1R (RBD, RBH, RAA, RAB, RAC)

(ii) Int Cl (Edition 5) H05K

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES: WPI

Search Examiner

C D STONE

Date of Search

16 SEPTEMBER 1993

Documents considered relevant following a search in respect of claims ALL

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	EP 0130410 A2 (NEC) See Figure 5	1
X	US 3991347 (AMP)	1, 3

-11-

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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